Neutrino Phenomenology

Theory Frontier Town Hall Meeting: TF11+

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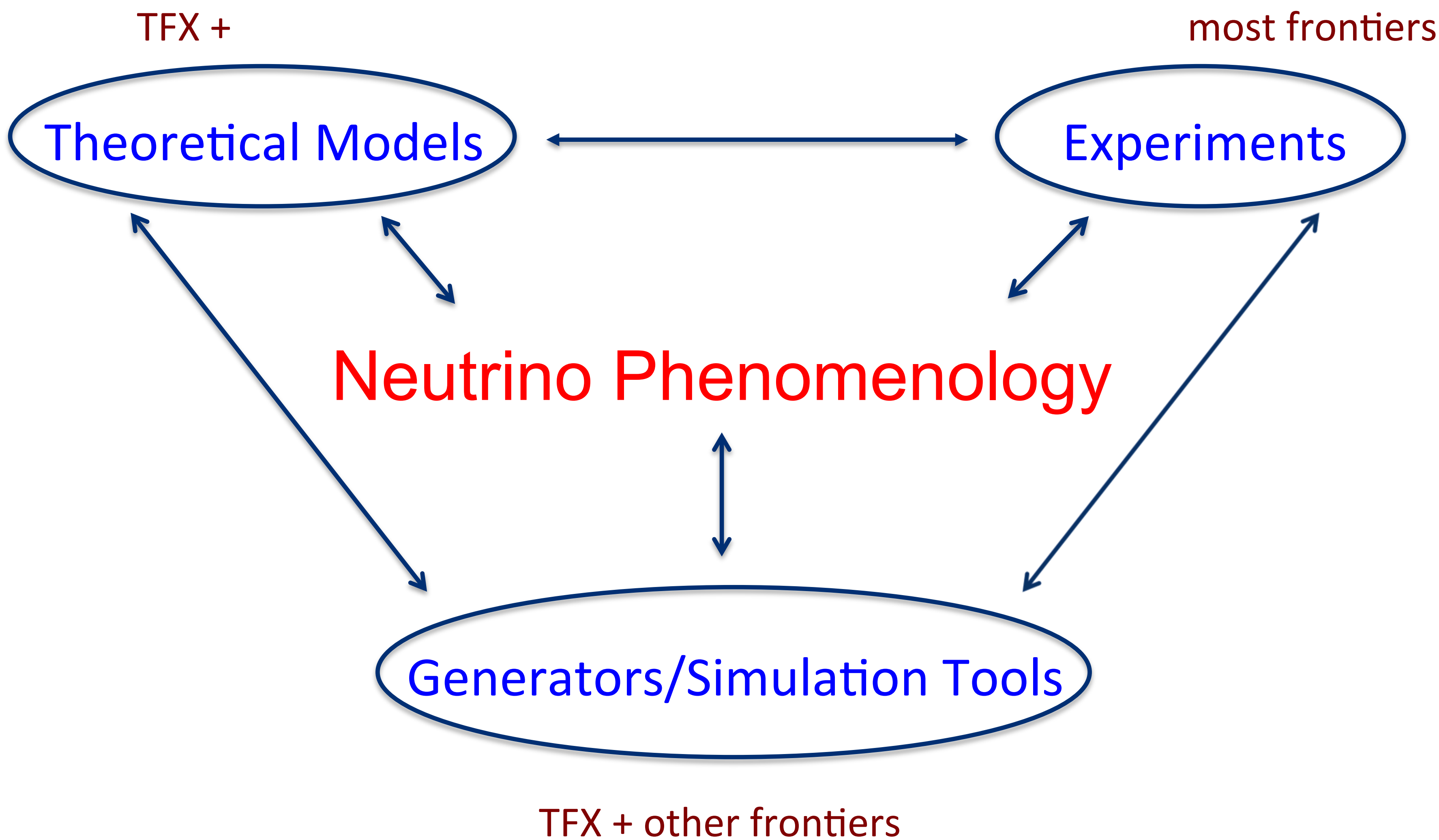
TFX +
most frontiers
Theoretical Models
Experiments
Neutrino Phenomenology
Generators/Simulation Tools
TFX + other frontiers

Neutrino Phenomenology

- What physics can we learn from present/planned experiments?
- For a given model (class) or effective theory, what are the implications for different types of experiments?
- How can we learn more from current/planned experiments?
- What other experiments should we think about to answer more of the physics questions?

Neutrino Phenomenology

- What physics can we learn from present/planned experiments?
  - precision measurements of already known properties
    (*e.g.* neutrino mixing angles and squared mass differences) NF
  - yet unknown properties
    (*e.g.* absolute neutrino mass, Majorana vs. Dirac, CP violation in the lepton sector, neutrino mass ordering, electromagnetic properties) TFX, NF, CF, RF, EF
  - BνSM
    - New interactions
    - New states
    - Connections to other sectors TFX, NF, CF, RF, EF
  - …

Neutrino Phenomenology

- For a given model (class) or effective theory, what are the implications for different types of experiments?

  - different types of neutrino experiments
  - implications for cosmology
  - implications in astrophysics
  - connections to collider experiments
  - connections with charged lepton measurements
  - …

(see Louis Strigari's presentation)

TFX, NF, CF, RF, EF

Neutrino Phenomenology

- How can we learn more from current/planned experiments?
  - Identify new observables and new ways of looking at data (*e.g.* background for one analysis becomes signal for another)
  - Global analysis of all types of available data
  - Consistent understanding of all ingredients needed to extract physics info from experimental observable (*e.g.* source modeling + neutrino interactions + oscillation physics + effects of systematic uncertainties)

    (see Saori Pastore's presentation)
  - New analysis framework (NSI+, leptonic unitarity tests,…)

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One Example: NSI

- Model Building: explicit theoretical models that generate large NSI and are consistent with all other constraints
- Effective theory: general parameterization with parameters to be constrained by data

- Data across many frontiers
  - matter effects in neutrino oscillations (vector-like NSI)
  - scattering experiments: many NSI structures.
    (different processes, high precision, high energy,…)
    e.g. $CE\nu NS$, IceCube astro ν, supernovae,…
  - collider experiments (e.g. monojet searches)
  - lepton or quark flavor experiments, rare processes, …

- Need consistent picture through complementary approaches

- Relevant to lots of frontiers/topical groups

Common goal: more/better physics understanding

- Snowmass organization = starting point
- Collaboration and coordination = necessity
    - do not miss anything important
    - do not duplicate effort
    - get coherent understanding and message
- Need participation across
    - Theory
    - Experiments
    - All Frontiers